The Bay Institute of San Francisco

The First Annual State of the Environmental Water Account Report

September 2001

The Bay Institute (TBI) is a nonprofit research, education and advocacy organization dedicated to protecting and restoring the ecosystems of San Francisco Bay, the Sacramento-San Joaquin Delta, and the rivers, streams and watersheds tributary to the estuary. For more information about TBI, call us at (415) 506-0150, write us at 500 Palm Drive, Suite 200, Novato, CA, 94949, or visit our website at www.bay.org.

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Executive Summary

In October 2000, the Environmental Water Account (EWA), an innovative and controversial new water management tool designed to protect fish from harmful impacts of federal and state water export operations without reducing water supply or deliveries from the Delta, was launched by the state and federal governments. Although it is an untested tool, the EWA has been weighted with enormous regulatory and fish protection responsibilities.

This report examines the origin of the EWA, how it was implemented in its first eventful year, and whether it fulfilled its promise of endangered species protection and recovery. Based on this analysis, The Bay Institute concludes that there are several critical problems that need to be resolved if state and federal agencies intend to continue implementing the EWA and basing Endangered Species Act (ESA) permit assurances on its performance.

1. The EWA implemented in Water Year 2000-2001 was incomplete, under-endowed, and constrained in its function. It was not the fish protection and water management tool promised by the federal and state governments. As a result, in March 2001 when endangered winter-run chinook salmon were being killed at the pumps at record rates, EWA-mediated export reductions were halted, despite continued losses of the fish to nearly 300% of the allowable ESA-mandated take limit. This shortcoming needs to be rectified immediately.

• All elements of the EWA, including the one-time deposit of 200,000 acre-feet of water and promised Tier 3 supplemental protections, should be fully in place by December 2001.

• More reliable funding sources, including volume-based user fees should be pursued.

• ESA assurances should be withheld at least until the EWA has been fully supplied with the required assets, operational tools, and Tier 3 supplemental protections, and should be voided if baseline regulatory protections and/or water project commitments are not fully satisfied during implementation of the EWA in any water year.

• Additional measures are necessary to allow greater flexibility in operating the CVP and SWP south Delta facilities, particularly to implement use of Joint Point of Diversion.

2. The EWA was designed to provide fishery protection at current levels of water project operations - it was not intended to mitigate impacts of additional new export, storage or conveyance. It was also intended to take advantage of the natural runoff events which effectively eliminate much or all of the impact to export water supplies. But in March 2001 new storage capacity allowed the SWP to bypass the reservoir used by EWA – a harbinger of things to come, inflating EWA costs and impairing its effectiveness.

• The EWA should not be used to offset foreseeable environmental impacts of changes in CVP and SWP export, storage and conveyance capacity.

• EWA size and operational tools must be adjusted to compensate for unforeseeable water project impacts as changes in CVP and SWP export, conveyance and storage capacity become operational.

• The EWA Interim Protocols should be modified to compensate for any reductions in the effectiveness of the EWA's variable assets that result from additional water project operational capacity.

3. Effective use of the EWA's limited resources for fish protection requires better information, better planning, and better use of and coordination with other environmental and non-environmental water management initiatives.

• Sufficient funding should be allocated to environmental water management programs that complement the EWA, such as the CALFED Environmental Water Program to acquire instream flows, and sufficient staff resources to coordination and integration between the EWA and other programs.

• Increasing environmental and biological monitoring, developing quantitative models, and refining decision guidelines are essential measures for improving the efficacy of the EWA as a fish protection tool.

4. The EWA is essentially a large scale and expensive experiment, which may or may not provide the benefits assumed in ESA permit assurances. It is imperative that the results of its actions be more accurately measured and evaluated.

• Specific hypotheses regarding the efficacy of EWA to reduce impacts of water project operations on fish species should be developed and tested using analyses of existing data, results of ongoing experiments, and modeling simulations.

• The EWA's effectiveness for reducing project-related impacts in the Delta and greater watershed should be evaluated using multiple indicators, including those for fish survival, movement and distribution, salvage rates, instream flows and Delta hydrodynamics, ecosystem function and habitat quality.

5. Cooperation and coordination between the fishery managers and the water project operators is a prerequisite for effective use of the EWA. Ambiguities and possible biases in forecasting and accounting should be clarified.

• The Interim Protocols for EWA Operations should be revised to clarify ambiguities and possible biases in base case accounting protocols, Article 21 water and San Luis Reservoir operations relative to EWA debt, and flexible and cooperative operation of the two pumping plants.

The First Annual State of the Environmental Water Account Report

In October 2000, the CALFED Bay-Delta Program[1] launched the Environmental Water Account (EWA), an innovative and controversial new water management tool designed to protect fish from harmful impacts of state and federal water export operations without reducing water supply or deliveries from the Delta. This report examines the origin of the EWA, how it was implemented in its first eventful year, and addresses several key questions:

- Did the EWA fulfill its promise of endangered species protection and recovery?
- How can the EWA be improved in the coming years?
- Is the EWA adequate to protect fish in the face of new water storage and conveyance projects?

Like some of CALFED's other programs, the EWA is an untested tool, a large-scale experiment to test a potential approach to less harmful water management. Unlike these other programs, however, the EWA has also been weighted with enormous regulatory and fish protection responsibilities. If it is to be scientifically justifiable and legally defensible, any flaws in design or performance must be exposed, evaluated, and remedied prior to the next year of implementation.

DEVELOPMENT OF THE ENVIRONMENTAL WATER ACCOUNT

California's Sacramento-San Joaquin watershed is one of the most highly modified and controlled hydrological systems in the world, with most of the development aimed at maximizing water storage, conveyance, and diversion for export to drier areas of the state. Both the Sacramento and San Joaquin Rivers, as well as all but one of their major tributaries, are dammed, blocking passage of many fish species, substantially altering seasonal flow patterns and magnitudes, and degrading downstream habitats. This vast watershed discharges into the upper portion of the San Francisco Bay-Delta estuary, the West Coast's largest estuarine ecosystem (Figure 1).

[1] A collaborative program of 24 state and federal agencies to develop and implement a plan to restore the Sacramento-San Joaquin watershed and Bay-Delta ecosystem, increase water supply reliability, improve water quality, and improve levee management and flood control.

The Delta is also highly altered, physically by levees, artificial channels and flow barriers, and hydraulically through upstream and in-Delta water management operations. Two huge pumping facilities are located in the southern Delta, one operated by the federal Central Valley Project (CVP) and the other by the State Water Project (SWP). Combined, these facilities are capable of extracting almost 30,000 acre feet (AF), or nearly 10 billion gallons, of water per day, although actual export rates vary with season, water year type (e.g., wet vs dry) and demand, and are presently limited by regulatory and operational requirements and Delta channel

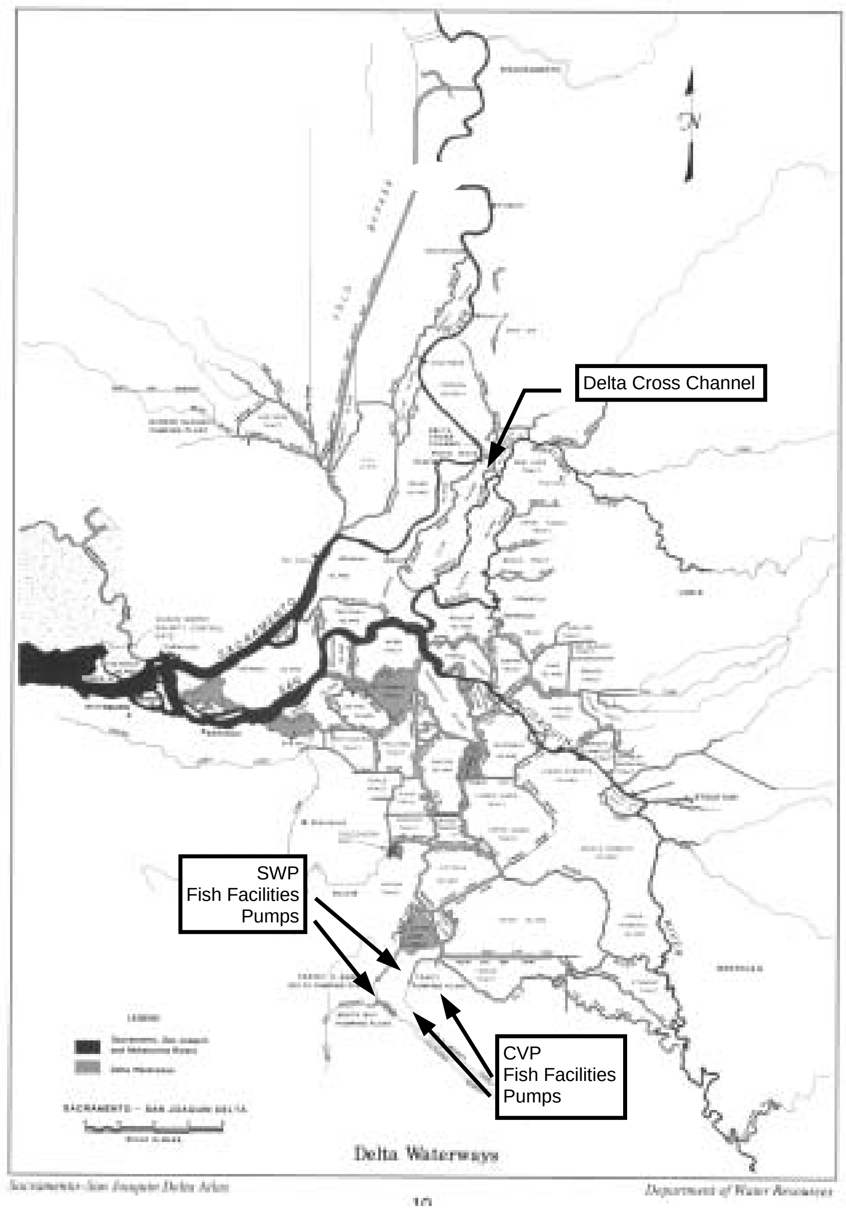

Figure 1. The Delta is the heart of the Sacramento-San Joaquin estuary, largest estuary on the west coast. It has been highly modified over the last 150 years and exploited as the main "switching station" for state and federal water projects transferring Sacramento basin water south to the San Joaquin Valley and southern California.

constraints. But even at moderate export rates, in-Delta circulation and flow patterns are significantly disrupted; at some times of the year, high CVP and SWP exports result in net upstream flow in the San Joaquin River between the its confluence with the Sacramento River and the pumps. The pumps also kill millions of anadromous and estuarine fishes drawn inexorably towards the south Delta by the artificial flows.

By the beginning of the 1980's, it was apparent that these water projects were seriously damaging the ecological health of the watershed and its diverse biological resources. Throughout the watershed but most critically in the Delta, fish populations were declining rapidly (Figure 2), even as water deliveries increased, a situation that was only exacerbated by the severe 1987 – 1992 drought. Both the state and federal governments repeatedly failed to respond to the potential collapse of the Bay-Delta ecosystem until well into the 1990s, when, propelled by litigation and lobbying by environmental and fishery conservation groups, endangered species protections were formally granted for some but not all species at risk, the Central Valley Project Improvement Act (CVPIA) was passed by Congress to reform management of the CVP, and the Bay-Delta Accord was negotiated to establish new water quality standards. In the new management landscape created by these changes in water policy, the CALFED Bay Delta Program was created in 1995 to first develop and then implement a long-term plan to restore the watershed's ailing ecosystem and protect fishery resources, and to improve water supply reliability, water quality, and flood control.

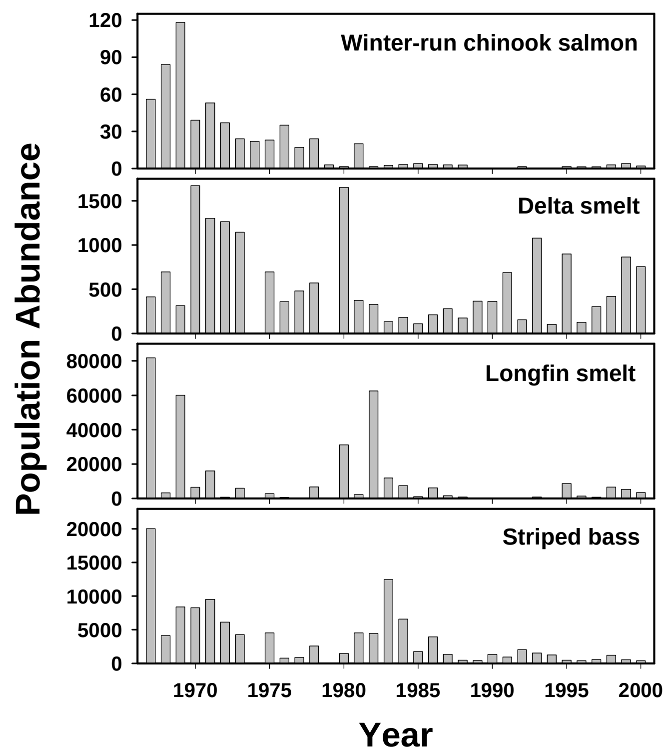

Figure 2. Population abundances of most fish species that rely on the Delta have declined dramatically over the past several decades.

Five years of discussion, study and negotiations by CALFED staff and agencies, agricultural, urban and environmental stakeholders, and other interested parties culminated in the CALFED Record of Decision (ROD), the formal adoption of

CALFED's proposed long-term plan, signed by the federal government and the State of California last year. The ROD and the accompanying Programmatic Environmental Impact Report/Statement outline the various components of the plan, including the Ecosystem Restoration Program (ERP), proposed expansions in CVP and SWP storage and conveyance capacity, a multispecies conservation plan, and, as the primary tool for protecting endangered fish species from water project operations, the Environmental Water Account (EWA).

Origin of the Environmental Water Account

During the 1990s, when several fish species with declining populations that rely on the Delta were granted protection under the ESA[2], severe conflicts between fish protection and water export operations began to occur. As required by law, the federal and state resource agencies responsible for protecting the fish (US Fish and Wildlife Service, USFWS, and National Marine Fisheries Service, NMFS) established a "take limit" on losses of endangered fish species at the CVP and SWP pumps to avoid causing jeopardy to the continued existence of the species. On numerous occasions these take limits were exceeded, prompting an ESA-mandated consultation between the resource agencies and the water project managers over how to modify export operations. Disputes over whether and how much exports should be cut almost always resulted in deferred and inadequate changes to project operations. Meanwhile the endangered fish continued to be destroyed at the pumps, and take limits were in effect not enforced. In those cases where an export reduction was made to protect the fish, it could disrupt water deliveries to south-of-Delta contractors and sometimes materially reduce the amount of water the projects were able to deliver. Project managers and water users were naturally resistant to making export cuts.

The concept of an Environmental Water Account, originally proposed by environmental groups engaged in the CALFED process, including the The Bay Institute, was intended to provide a buffer for endangered species by acquiring water that would be immediately available for fish protection while longer-term arrangements were being made between the resource agencies and the water project operators. This concept was adopted by CALFED and export water users and transformed into a mechanism for providing fish protections without ever impacting project supplies.

Designing the Environmental Water Account

Armed with a promising but sketchy concept for an EWA, technical staff from CALFED, state and federal agencies, and water user and environmental stakeholder

[2] Federal ESA status and listing dates: Winter-run chinook salmon, endangered, 1994; Delta smelt, threatened, 1993; Steelhead (Central Valley ESU), threatened, 1998. Spring-run chinook salmon, threatened, 1999; Sacramento splittail, threatened, 1999.

groups embarked on a series of studies and computer modeling exercises to explore various approaches and configurations for this novel fish protection and water management tool. How big should the EWA be in order to reliably accomplish desired fish protections without impacting deliveries? How much fish protection could the EWA provide? What kind of operational modifications were most effective? How should the EWA benefit from state and federal actions to expand water storage and export capacity? How should the EWA be integrated with other environmental and fish protection programs?

The group used a 14-year sequence (1980-1994) of data on hydrology, water supply, water management operations, and project impacts on fish resources as input for the computer models. Then, using real-time "gaming" to manipulate water management operations in the models, they simulated and tested the effects of various EWA actions on the water projects and fish resources, for example evaluating the result of an export reduction on storage, deliveries, and the number of fish killed at the pumps. The games were conducted using a range of baseline conditions, EWA water asset portfolios, and EWA operating rules. Midway through the games it became clear that, for optimal use of environmental water, EWA operations needed to be integrated with those for the 800,000 acre feet of environmental water specified by the Central Valley Project Improvement Act (CVPIA), called "(b)(2)" water, setting the stage for the current collaborative operation of these two fish protection tools. One of the final games tested baseline regulations, final (b)(2) accounting rules, and a suite of EWA and water project tools and assets nearly identical to those ultimately described in the ROD for the early years of the CALFED program (i.e., Stage 1, 2000-2006). The results of this game provided the basis for CALFED's final configuration of the EWA, its size, operating rules, and integration with other environmental and fish protections.

Based on our participation in and evaluation of the gaming

Central Valley Project Improvement Act (b)(2) Water

Section 3406 (b)(2) of the Central Valley Project Improvement Act (CVPIA), signed into law in 1992, specifies that 800,00 AF of Central Valley Project yield be used for environmental protection and restoration of fish and wildlife. This "(b)(2)" water is nominally managed by the U.S. Fish and Wildlife Service, although up to 450,000 AF of the amount is used to satisfy the CVP's responsibilities for meeting the state's Delta standards. The rest is usually used to enhance instream flows on CVP-controlled streams and reduce export rates and associated fish losses at the CVP pumps in the Delta, primarily for the benefit of anadromous fishes like chinook salmon and steelhead.

process and its results, the The Bay Institute identified a number of structural and operational issues that needed further attention before the EWA was finalized and implemented, concerns detailed in memoranda to CALFED dated April 4, 2000 and July 7, 2000. Our analyses concluded that:

- The EWA, as it was operated in the final game, would not satisfy ESA-mandated protections such as take limits for several endangered fish species.
- Methods for evaluating the efficacy of the EWA for protecting and promoting recovery of endangered fishes were poorly developed, and EWA actions poorly integrated with CALFED's other programs.
- The scale of EWA actions would be insufficient to offset the additional impacts of CALFED's proposed increases in export and storage capacity.
- Based on these conclusions, the EWA should be implemented on an experimental basis but it would be premature to link regulatory assurances to this untested water management tool.

What is the Environmental Water Account?

In its final form, which is detailed in the ROD and accompanying EWA Operating Principles Agreement, the EWA became an integral component of CALFED's Water Management Strategy and the key program supporting CALFED commitments to protect fish from water project impacts, although it was officially authorized for only four years.

The EWA is a supply of water and water management tools managed by the USFWS, NMFS, and California Department of Fish and Game (DFG), collectively referred to as the Management Agencies. The Management Agencies use the EWA to modify CVP and SWP operations, primarily to reduce the direct impacts of the South Delta pumps on fishes in the Delta, and also to improve instream and Delta habitat conditions. For example, the EWA can release water from a reservoir to improve instream flows for chinook salmon, or reduce export rates in the Delta when delta smelt are concentrated near the pumps and vulnerable to lethal entrainment. If an EWA fish protection action results in reducing the amount of water ultimately delivered by the CVP or SWP, the project is compensated in the amount of the shortfall with water from EWA supplies. Effectively, the EWA uses its water, paid for exclusively from public funds, to assume the risk to water deliveries of operating the water projects flexibly in a manner that minimizes harmful impacts on fish and the environment.

The stated purpose of the EWA is to "provide water for protection and recovery of fish beyond that available through existing regulatory actions" by making "environmentally beneficial changes in SWP/CVP operations at no uncompensated cost to the projects' water users" (ROD, pp. 54). Thus, protection and habitat benefits afforded by the EWA and use of its water are supplemental to other fish and environmental protections already in place and identified by CALFED as the "baseline level of protection". Baseline protections include the 1995 Water Quality Control Plan (WQCP), full use of CVPIA (b)(2) water, and selected protections contained in the ESA-required Biological Opinions[3] for winter-run chinook salmon and delta smelt[4]. The commitment from fisheries agencies that they will require no additional water for protection of ESA species, in the eyes of The Bay Institute and other environmental groups the most controversial element of the EWA, is granted annually and premised on implementation of a three-tiered suite of protections, all of which are required to be fully funded and available.

Funding for the EWA is to be provided jointly by the State and Federal governments, and can be used purchase, bank, transfer, borrow and convey water. The EWA is also allowed to sell its water assets.

CALFED's Three Tiers of Protection

Tier 1 consists of the baseline protections and water encompassed in the WQCP, full use of CVPIA (b)(2) water, and selected portions of the Biological Opinions for winter-run chinook salmon and delta smelt[4].

Tier 2 consists of a fully funded and operational EWA combined with benefits afforded by a fully funded and active Ecosystem Restoration Program.

Tier 3 consists of the commitment of CALFED Agencies to make additional water available should it be needed for species protection when combined protections of Tiers 1 and 2 are inadequate. Decisions to use Tier 3 measures are to be made in consultation with an independent science panel.

[3] A Biological Opinion is developed after formal consultation between federal fisheries agencies and the CVP and SWP when a fish species impacted by their operations is listed under the ESA. For each listed species, the document details the allowable limits of project operation, for example minimum flow requirements in a dammed river or the maximum number of fish that can be killed within a specified period at the pumps, referred to as the take limit.

[4] Most of the environmental protections specified in the Biological Opinion for delta smelt, are baseline, or Tier 1 protections; export reductions in excess of 1:1 associated with the April 15 – May 15 San Joaquin River pulse, however, are Tier 2 protections. SWP water costs resulting from satisfying the additional 30 day export reductions are charged to the, the EWA, and CVP costs are charged to the (b)(2) account.

The EWA can acquire water in three ways:

- ***Purchase water from willing sellers***
- ***Borrow water from stored or contracted supplies***
- ***Acquire water by relaxing the Export/Inflow Ratio or using excess operational capacity***

The EWA can buy water or water options from willing sellers at market based rates. CALFED projected that, on average, the EWA would need to purchase 185,000 AF each year, with 150,000 AF from south-of-Delta sources and 35,000 AF from north of the Delta. Purchased water may be kept in storage for the entire water year (or longer at some groundwater storage sites) and, with some limitations, called upon at any time by EWA managers. For both surface and groundwater storage, EWA rights are junior to most other users. For example, EWA water stored in a surface reservoir that later fills to capacity with project water is lost or "spilled". Groundwater storage eliminates this risk but EWA access to this water may be restricted by limited extraction rates or, during periods of high demand by other users, the EWA may be denied access to the groundwater pumps. Costs of pumping groundwater are also relatively high.

The EWA can borrow water from federal, state or local water projects or their contractors, using its own water assets that may be stored elsewhere as collateral for the loan. For example, the EWA may borrow an amount of water stored in an upstream reservoir during the fall or winter and release it to enhance stream flows below the dam or in the Delta. If the reservoir subsequently fills during the spring, the EWA's debt is cancelled because water deliveries from that reservoir have not been reduced. If the EWA action prevents the reservoir from filling, the shortfall is compensated using EWA assets. The EWA can similarly borrow water in San Luis Reservoir[5], for example, to cover the cost of an export reduction, with the expectation that if San Luis Reservoir fills, the debt is cancelled. In addition, the EWA is explicitly allowed to borrow 100,000 AF of water from CVP or SWP south-of-Delta water contractors and store it for use as collateral in San Luis Reservoir. This transaction is called a source shift because, during the period of the loan, the contractor agrees to use water from other sources. For all borrowing agreements, the EWA is required to identify assets sufficient to cover the transaction in the event the debt is not erased by favorable hydrology.

[5] San Luis Reservoir is the main export surface storage reservoir located south of the Delta. It is operated jointly by the CVP and SWP, which share the storage space equally.

The EWA can also acquire water by relaxing the regulatory Export/Inflow (E/I) Ratio[6] and utilizing excess export capacity, tools collectively referred to as “variable assets”. As the term suggests, the amounts of EWA water acquired through use of these tools each year will vary depending on hydrologic conditions, fish distributions and other environmental factors. Based on the modeling exercises, some variable tools yield more water for the EWA in dry years, for example SWP pumping of (b)(2) upstream

EWA Variable Assets

Relaxation of the Export/Inflow (E/I) Ratio: During periods when Management Agencies determine that excess pumping would not be harmful, the EWA can request that the E/I ratio be increased, above the level specified in the WQCP and CALFED regulatory baseline, and allow more Delta water to be exported. For example, during the winter or spring when the maximum allowable E/I ratio is usually 35%, the EWA may allow exports to increase to 40% of inflow. All of the excess water above the baseline 35% E/I ratio is dedicated to the EWA and can be stored or used south of the Delta. Projected average annual acquisition: 30,000 AF.

500 cfs increase in SWP pumping: During the summer months, the EWA can allow SWP pumping rates to be increased by 500 cfs above the presently permitted limit of 6,680 cfs. All of the extra water exported, above the 6,680 cfs rate, is dedicated to the EWA for storage or use south of the Delta. Projected average annual acquisition: 50,000 AF.

SWP pumping of (b)(2) and ERP upstream releases: Under certain conditions, environmental water that is released upstream for either ERP or (b)(2) purposes can be captured and exported by SWP when it arrives in the Delta, so-called “state gain”. Half of this water is deeded to the EWA. Projected average annual acquisition: 40,000 AF.

Joint Point of Diversion: Under certain conditions, the SWP, which has nearly twice the pumping capacity of the CVP, can use its excess capacity to pump water for the CVP and EWA, with the extra water shared equally between the CVP and EWA. In the current EWA Operating Principles Agreement, only SWP pumping of CVP or EWA water is identified. Projected average annual acquisition: 75,000 AF.

[6] Relaxation of the E/I ratio under certain conditions was already allowed under the 1995 WQCP.

releases, while others, such as Joint Point of Diversion, are more productive in wetter years. In all cases, use of the tools to acquire water for the EWA requires additional pumping and must therefore be balanced against the risks to fish and the ecosystem. For example, elevated Delta inflow from a rainfall event could offer an opportunity to relax the E/I ratio (while still meeting Delta outflow requirements) and export water for the EWA to store south of the Delta. However, if salmon are migrating downstream, behavior often associated with a pulse in stream flows, the EWA may prefer to reduce export rates to enhance survival of the fish rather than allow extra pumping.

In addition to these annual water acquisitions, in its first year of operation, the EWA was to be endowed with a one-time deposit of 200,000 AF of water stored south of the Delta (or its functional equivalent[7]). This initial deposit was considered necessary to ensure the effectiveness of the EWA because it would provide the collateral necessary to guarantee CVP and SWP deliveries. Possession of water assets located south of the Delta is critical to the EWA, particularly in dry years when natural hydrology may prevent the EWA from recouping its expenditures through use of variable assets or debt forgiveness in reservoirs.

The EWA can use its water to make environmentally beneficial changes in water project operations, including:

- ***Reducing export rates at the CVP and SWP Delta pumps***
- ***Enhancing flows in selected streams***
- ***Increasing Delta inflow or outflow.***

In the Delta, the EWA can modify export operations at the CVP and SWP, usually calling for short-term reductions in exports during periods when sensitive fish species are vulnerable to the pumps (see box next page). Reducing the amount of water exported is presumed to correspondingly reduce the numbers of fish entrained and killed at the pumps. For example, when more than 400 delta smelt are taken at the pumps per day (as a 14-day running average, the "yellow light" trigger for taking protective action), the EWA could call for exports to be cut by 50% with the object of reducing the number of fish taken per day by the same proportion.

The EWA can modify reservoir operations to release additional water downstream. For example, when returning adult chinook salmon are detected entering

[7] Although not explicitly stated in the ROD or EWA Operating Principles Agreement, this water was anticipated to be stored as groundwater and, in any given year, only 100,000 AF of the total amount was projected to be extractable or immediately available to compensate for EWA impacts on deliveries.

Fish Protective Facilities

Immediately upstream of the CVP and SWP pumps, each water project operates a fish protective facility (Figure 1) designed to screen fish from diverted water and collect them in holding tanks for later transport by truck to release sites in Delta. This process, called salvage, includes regular counts and identification of the fish collected at the facilities. The number of fish lost (i.e., killed) each day at each facility is calculated based on these counts and several other factors, including measured pre-screen predation rates and screen efficiency. For example, DFG field experiments with chinook salmon indicate that 75% of the fish entering Clifton Court Forebay, the large gated embayment that supplies water to the SWP pumps, are eaten by larger fish or birds before they even reach the fish screens and are collected for counting.

Aerial view of the SWP Skinner Fish Protective Facility.

the Delta, the EWA could call for increased flows on the Feather River to attract the fish and improve habitat conditions for spawning and egg incubation. The EWA also decides whether to allow this extra water to flow through the Delta, improving habitat conditions there, or allow the SWP to export the water, recapturing most of the water for later EWA use.

The EWA was designed and sized to operate in concert with the CVPIA (b)(2) water. Like the EWA, (b)(2) water is used to improve environmental conditions and reduce water project impacts on fish resources using carefully timed, targeted instream flow enhancements and export reductions. Unlike EWA impacts, reductions in CVP deliveries resulting from (b)(2) actions (up to a total of 800,000 AF) do not have to be paid back. A portion of the (b)(2) water is used to satisfy the WQCP standards encompassed in the Tier 1 regulatory baseline. Coordinated use of the two environmental water supplies offers opportunities for efficiency and synergy. For example, when an export curtailment is needed to protect fish near the pumps, (b)(2) water may be used to support the cut at the CVP while the EWA reduces exports at the SWP. The EWA can also directly benefit from upstream (b)(2) actions by acquiring 50% of any (b)(2) water captured and exported by the SWP.

In addition to EWA-mediated modifications in instream flows and exports, the Management Agencies can also modify in-Delta hydrodynamics by controlling flow through the Delta Cross Channel (DCC) (Figure 1) and several temporary agricultural barriers located in the southern Delta, protective actions described in the Biological Opinions and covered under the regulatory baseline. For example, during the period from November to January, the DCC gates are typically closed when Sacramento basin juvenile chinook salmon and steelhead are detected migrating downstream to prevent the young fish from being drawn into the central Delta where their survival is known to be significantly reduced.

The Delta Cross Channel

The Delta Cross Channel (DCC) is a gated, man-made canal connecting the Sacramento and Mokelumne Rivers. When the DCC gates are open, Sacramento River water flows through the canal and into the central Delta, decreasing central Delta and export water salinities and thus increasing the amounts and quality of the water that can be pumped by the CVP and SWP. Under the Tier 1 regulatory baseline, the gates are closed in the spring (February 1-June 30) and open during the summer and fall (July1-October 31). From November to January, the gates can be closed for a total of 45 days at the discretion of the Management Agencies for the protection of juvenile chinook salmon and steelhead. Reductions in water deliveries incurred by any additional DCC closures for fish protection are compensated by the EWA.

Aerial view of the Delta Cross Channel.

IMPLEMENTATION OF THE ENVIRONMENTAL WATER ACCOUNT

Implementation of the EWA in Water Year 2001[8], including ESA permit assurances, required that the Project Agencies (US Bureau of Reclamation, USBR, and California Department of Water Resources, DWR) provide the Management Agencies with a fully funded and operable EWA. Specific requirements included a secure funding source, the suite of fixed (i.e., water) and variable assets defined in the EWA Operating Principles Agreement in the ROD and, and in this first year, a one-time deposit of 200,000 AF of water (or equivalent) stored south of the Delta. Although ESA assurances were predicated on CALFED's three-tiered protection plan, Tier 3, explicitly identified in the ROD but deemed unlikely to be needed, was not addressed. Instead CALFED promised to prepare an implementation strategy for Tier 3 by August 2001, including a timely scientific panel process, and operational tools and funding for acquiring the additional water. As of September 2001, limited Tier 3 funding has reportedly been secured but none of the other required components, including an implementation strategy, operational tools and scientific panel process, have been identified or described. Full funding and implementation of the CALFED Ecosystem Restoration Program was also required.

Meanwhile, Management Agency scientists, many of whom participated in EWA development and the gaming exercises, were planning how to the use the EWA in the upcoming year. This included making a monthly budget for the EWA, projecting when fish protection actions would likely be needed and how much water would be required. They also developed guidelines for initiating and terminating EWA fish actions, with triggers based on monitoring data, environmental conditions, and population status for juvenile chinook salmon and delta smelt, but not for steelhead or splittail.

Hydrology in Water Year 2001

Water Year 2001 was a dry and somewhat unusual year, an unwelcome (but not unexpected) surprise after the preceding five-year span of wet years. The amounts and timing of precipitation during the year substantially influenced EWA water acquisition and fish protection costs and operations.

Most of the early EWA water purchases were negotiated in 2000, before it became apparent that the upcoming water year would be dry. Water purchases made later, in 2001, were more difficult and costly, particularly in the south-of-Delta export area, indicating that price and availability of water for purchase by the EWA could be strongly influenced by hydrology

Fish protections were also complicated. The early part of the year was dry enough to trigger a change in baseline standards, allowing a 45% E/I ratio in February

[8]The water year is from October 1 through September 30.

instead of the usual 35%. Then, heavy precipitation in February increased the amounts of Delta inflow available for export even as it stimulated the delayed outmigration of juvenile salmonids. Simultaneous opportunities for high levels of export and high priority fish protection needs increased EWA costs - cutting exports to planned protective levels costs more water when the allowable exports are higher. The return to dry conditions in March, as well as certain operational decisions by the SWP, prevented the SWP from filling San Luis Reservoir, precluding the EWA from recouping its costs by spilling debt. The final anomaly occurred in early June when a leak was discovered in the SWP's California Aqueduct, resulting in complete shutdown of SWP export operations for several weeks (although a Joint Point of Diversion for the CVP to pump water for the SWP was approved and implemented).

Acquisition of Assets

For Water Year 2001, because there was no federal allocation for CALFED, funding to support EWA water purchases, funding for operational costs (e.g., power, conveyance fees), water accounting, and environmental documentation was provided exclusively by the State, and EWA actions were limited to modifying SWP operations. However, in October 2000, the federal Central Valley Project directly contributed 72,000 AF of water stored in San Luis Reservoir to the EWA. As of September 2001, the EWA had spent (or encumbered) approximately $59,000,000, with nearly all of that amount used to purchase water.

The Project Agencies began acquiring water for the EWA late in 2000 and continued adding to the EWA portfolio throughout the water year. The initial contribution of water stored in San Luis Reservoir was followed by small amounts of water acquired through use of variable assets, a disappointing 2,000 AF from relaxing the E/I ratio in October and 11,000 AF from SWP pumping of (b)(2) water in December[9]. Several contracts to purchase water from willing sellers north and south of the Delta were negotiated. In a January 11, 2001 letter to the Management Agencies[10], heads of the USBR and DWR detailed their progress towards provisioning the first year's EWA and officially requested assurances that no additional water would be required for ESA fish protection. The letter stated that nearly all of the required fixed assets, including most of the one-time 200,000 AF acquisition, had been acquired or would be in place by February. The variable assets, like use of Joint Point of Diversion and excess SWP pumping capacity, were available and their use for acquisition of EWA water was anticipated to occur throughout the water year. On this basis and on the

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[9] In October and November 2000, the EWA was denied a substantial amount of "state gain" water (>10,000 AF) because of a past obligation owed to the SWP by the CVP and (b)(2) account. SWP-pumped (b)(2) water that would have been credited to the EWA was instead transferred to the SWP.

[10] This letter and the Management Agencies' reply are available on the CALFED Operation Group website at http://wwwoco.water.ca.gov/calfedops/2001ops.html.

understanding that remaining acquisitions and agreements would soon be completed, the Management Agencies granted the request for ESA assurances.

Table 1 (next page) summarizes EWA asset acquisitions in Water Year 2001, comparing CALFED's projected average annual acquisitions to that reported by the Project Agencies in January and the amounts actually acquired as of the end of the water year. Despite optimistic predictions, the EWA began and ended its first year seriously under-endowed. By March, when the greatest demands for fish protection occurred, the EWA had accumulated less than 180,000 AF of water and had "spent" nearly all of it (Figure 3). At the end of September 2001, the EWA reported acquisitions totaling 303,000 AF (excluding the source shift) with nearly all of the water acquired as purchases. With this year's dry hydrology, low Delta inflows, and delayed and prolonged salmon outmigration, the EWA had few opportunities to utilize excess pumping capacity or safely relax the E/I ratio. As a result, water acquisition through use of the variable assets netted the EWA only 12% of average projected amounts. The largest and most serious shortfall was for the one-time acquisition of 200,000 AF intended to endow the new EWA with sufficient collateral to buffer CVP and SWP deliveries against the impacts of fish protective actions. As of September 2001, none of this water had been acquired, although greater than anticipated amounts of water purchased both north and south of the Delta, approximately 87,000 AF more than required[11], could be interpreted as providing some "functionally equivalent" assets.

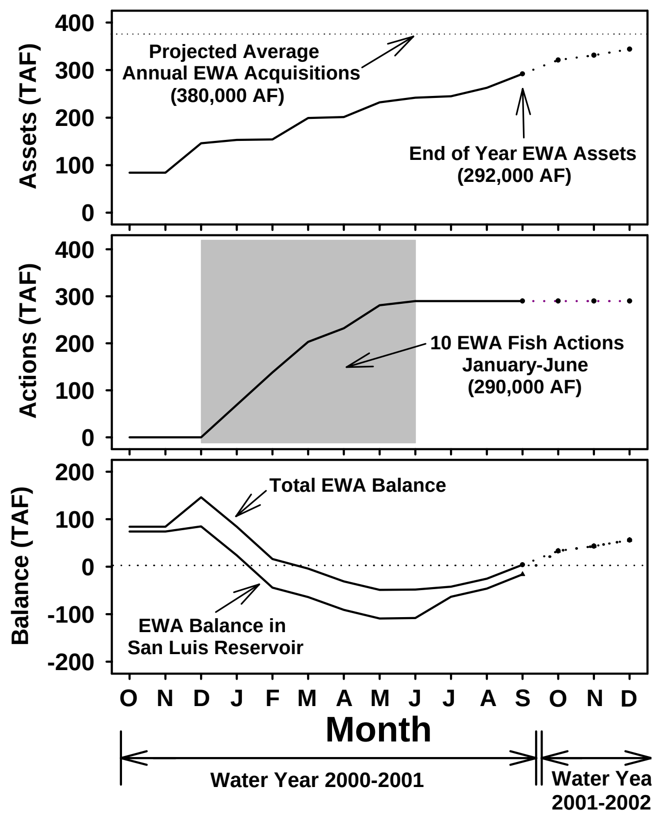

Figure 3. EWA assets acquisition, expenditures, and balance in San Luis Reservoir during Water Year 2001.

[11] This amount incorporates carriage losses of EWA water purchased north of the Delta during its transfer to south of the Delta.

Table 1. Comparison of EWA asset acquisition projected in the CALFED ROD, reported by the Project Agencies in January 2001, and actual asset acquisition during the Water Year 2001 water year.

Type of Asset	**Projected Average Annual Assets** (AF)	**Assets reported available January 2001** (AF)	**Assets acquired as of September 2001**[1] (AF)	**Difference between Projected and September 2001** (AF)
Water purchases				
• North of Delta	35,000	60,000	80,000[2]	+ 45,000
• South of Delta	150,000	253,000	199,000	+ 49,000
Variable Assets				
• SWP pumping of (b)(2) or ERP water	40,000	19,000	22,000	- 18,000
• Joint Point of Diversion	75,000		0	- 75,000
• Export/Inflow ratio flexibility	30,000	2,000	2,000	- 28,000
• 500 cfs SWP pumping increases	50,000		0	- 50,000
ANNUAL TOTAL	380,000	334,000	303,000[2]	- 77,000
Source Shift	100,000	100,000	100,000	0
One time acquisition 200 TAF stored south-of-the-Delta	200,000[3]	165,000	0	- 200,000[4]
FIRST YEAR TOTAL	680,000	678,000	403,000	- 277,000

[1] Data for Water Year 2001 EWA assets through September are from the CALFED Operations Group EWA Asset Acquisition Accounting Summary, 9/20/01.

[2] Total north of Delta acquisition was 80,000 AF, however 15% of this water will be lost as carriage water during transfer through the Delta, resulting in net EWA assets of 68,000 AF south of the Delta for compensating delivery impacts, and total EWA assets south of the Delta of 291,000 AF.

[3] Of the required 200,000 AF, only 100,000 AF of the total amount was projected to be extractable or immediately available to compensate for EWA impacts on deliveries in any single year.

[4] Some of this shortfall may be considered offset by purchased water above the projected average annual amounts, possibly as much as 87,000 AF, which is considered to be "functionally equivalent".

EWA Fish Protection Actions

In Water Year 2001, the EWA implemented ten fish protection actions[12], all between January and July and all but one of them export curtailments at the SWP (Figure 4, next page). Total EWA expenditures for the year were 290,000 AF, approximately 82% of the average annual EWA expenditures made in the gaming exercises during dry years and 66% of average amounts used per year during the entire 14-year sequence, suggesting that the EWA was operated somewhat conservatively in its first year.

Implementation of EWA fish protection actions was directed by teams of CALFED and agency scientists and water project operators, with input from water user and environmental stakeholder representatives, and coordinated with the (b)(2) Interagency Team.[13] Decisions to implement an action were based on evaluation of real-time biological, environmental, and operational monitoring data and projections, integrated with decision guidelines developed for the various fish species, and then balanced against availability of EWA assets (or (b)(2) water) to support the action (using both the expected annual and monthly allocations based on predicted fish protection needs), and other anticipated fish protection needs in the future. Recommendations for project operation modifications were subsequently authorized (or not) by the Water Operations Management Team and executed by CVP and SWP operators.

Scientific and Regulatory Justifications for EWA actions

The EWA is responsible for promoting protection and recovery of endangered and threatened fish species, most notably limiting the numbers of fish killed, or “taken”, at the pumps to levels below the take limits specified in the projects’ permits outlined in the Biological Opinions. This year, quantitative take limits were established for only winter-run chinook salmon juveniles and delta smelt. An interim, or draft, take limit was suggested for steelhead (and later modified) but no specific targets were set for either spring-run chinook salmon or splittail. Ensuring that incidental take limits were not exceeded provided a basic rationale for EWA actions, in particular export curtailments to avoid or reduce direct take of listed species.

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[12] Descriptions of EWA Fish Actions are posted on the CALFED Operations Group website at http://wwwoco.water.ca.gov/calfedops/2001ops.html

[13] EWA implementation is coordinated through the EWA Team (comprised of a CALFED coordinator and Management and Project Agency representatives), the Data Assessment Team (DAT, CALFED and agency scientists, project operators, and water user and environmental stakeholder representatives), the Water Operations Management Team (WOMT, Management and Project Agency managers), the CALFED Operations Group, the Operations and Fisheries Forum (OFF, stakeholder representatives), and the (b)(2) Interagency Team.

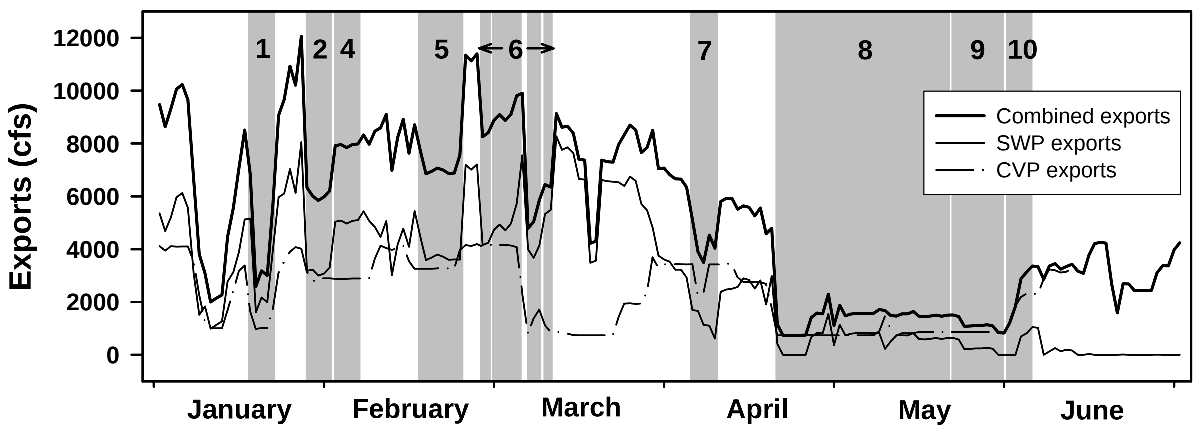

Figure4. EWA Actions for Fish Protection

Fish Action 1: Export curtailment, from an estimated base operation of 8,200-10,200 cfs combined exports, to 3,000 cfs for the 3-day long experiment and to 5,000 cfs for other two days, to protect juvenile winter-run chinook salmon and to provide specified experimental conditions for an experiment using radio-tagged juvenile chinook salmon released in Old River (south Delta). Coordinated export reductions were made at the SWP, compensated for using EWA water assets, and at the CVP using (b)(2) water.

Fish Action 2: Export curtailment, from an estimated base operation of 11,600-11,900 cfs combined exports to 6000 cfs for a 5-day period, to protect juvenile winter-run chinook salmon and steelhead. The SWP portion of the export reduction compensated for with EWA water and the CVP export reduction made using (b)(2) water.

Fish Action 3: Flow enhancement on the American River to protect chinook salmon and steelhead redds (nests) from dewatering and adverse environmental conditions. Flows were increased from 1,000 cfs, the minimum allowable, to 1,500 cfs for the month of February. Although this action was authorized as an EWA action, water costs were later attributed to the (b)(2) account.

Fish Action 4: SWP export curtailment, from an estimated base operation of 10,500 cfs combined exports to 8000 cfs for a 5-day period, to protect juvenile winter-run chinook salmon and steelhead.

Fish Action 5: SWP export curtailment, from an estimated base operation of 9,500 cfs combined exports to 7000 cfs for an 8-day period, to protect juvenile winter-run chinook salmon and steelhead, and adult delta smelt moving upstream into the Delta to spawn.

Fish Action 6: A series of SWP export curtailments, from an estimated SWP base operation of 7,000-8,600 cfs to SWP exports of 4,000-6,000 cfs over a period of 12 days, to reduce take of winter-run chinook salmon, steelhead and delta smelt.

Fish Action 7: SWP exports reduced by 2,000 cfs from estimated base operations for five days to protect spring-run chinook salmon, San Joaquin River fall-run chinook salmon, steelhead, and delta smelt.

Fish Action 8: Combined SWP-CCVP exports curtailed to 1,500 cfs for 30 days, as per the Vernalis Adaptive Management Plan (VAMP). Reduced exports, combined with enhanced San Joaquin River flows, are intended to protect San Joaquin River fall-run chinook salmon and delta smelt and are part of a 12-year experiment investigating the relative effects of river flows and export rates on chinook salmon survival. The SWP portion of the export reduction compensated for with EWA water and the CVP export reduction made using (b)(2) water.

Fish Action 9: Combined SWP-CVP export curtailment to maintain export rates at 1,500 cfs combined through May, to protect San Joaquin River fall-run chinook salmon and delta smelt. The SWP portion of the export reduction compensated for with EWA water and the CVP export reduction made using (b)(2) water.

Fish Action 10: Combined SWP-CVP exports were increased gradually over a 5-day period, to protect San Joaquin River fall-run chinook salmon and delta smelt. The SWP portion of the export reduction was compensated using EWA water.

Specific recommendations for fish protective actions using the EWA (or (b)(2) water) were based on results of a variety of studies and observations relating fish survival to environmental conditions and water project operations.

- Enhanced river flows increase wetted river area, spawning habitat for anadromous and resident fishes, and improve environmental conditions such as water temperature that are particularly important for incubating eggs and young fish.
- Enhanced Delta outflows, particularly during the spring and early summer improve survival of estuarine species like delta smelt by shifting low salinity estuarine habitat downstream.
- Enhanced San Joaquin River flows in and upstream of the Delta improve survival of outmigrating San Joaquin basin chinook salmon and steelhead, as well as other Delta species like delta smelt and splittail.
- Reduction in export rates proportionally reduces the numbers of fish killed at the pumps and may improve survival further by indirectly improving Delta habitat conditions through enhanced San Joaquin River and Delta outflows.
- Survival of juvenile Sacramento basin chinook salmon migrating through the Delta is improved when the DCC gates are closed.
- Survival of juvenile chinook salmon migrating through the Delta is reduced when CVP and SWP combined exports exceed 6000 cfs.
- Delta smelt are

ESA "Take Limits"

Within the Delta, SWP and CVP operating permits require that the projects limit their impacts, measured as the number of fish killed, on an endangered species to within a specified allowable level, defined as the take limit. The specific take limits established for SWP and CVP project operations do not necessarily reflect a population-based threshold value below which the species is unaffected. Rather they are calculated from the historical levels of project impacts on the species. For example, prior to ESA listing, the SWP and CVP typically killed 1-2% of all juvenile outmigrating winter-run chinook salmon, therefore the ESA-mandated take limit for this species holds the projects to similar levels of impact, 2% of the estimated number of juveniles. The number of juvenile winter-run chinook salmon is calculated from counts of returning spawners in the previous year, estimated fecundity, and predicted survival of the eggs and young juveniles in the river before they begin their downstream migration, all adjusted based on environmental conditions in the river, such as water temperature.

more vulnerable to entrainment and loss at the pumps when they are distributed in the central and southern Delta than when they are distributed in the northern or western Delta and Suisun Bay.

The timing and location of EWA actions was guided by environmental and biological monitoring conducting throughout the lower watershed and Delta and decision criteria developed for juvenile salmonids and delta smelt. For example, outmigrating juvenile winter-run chinook salmon were detected and their progress tracked at sampling locations in Sacramento River tributaries, several locations on the Sacramento River itself, the upper and lower Delta, and at the CVP and SWP fish facilities. If results from selected sample sites approached or exceeded specified trigger values, the Data Assessment Team (DAT) initiated a teleconference to discuss options and recommend protective actions. For delta smelt, data from regular in-Delta surveys of distribution and abundance were also incorporated into hydraulic and particle tracking models to analyze the potential effects of EWA actions (or other discretionary baseline actions) on fish distributions and salvage.

Accounting for EWA Actions

Calculating the effects of EWA actions on water project deliveries, essentially the EWA's water costs, was the responsibility of the Project Agencies. It was a complicated process incorporating use of forecasting, hydrologic and operations models, and judgments of water project operators. First, the Project Agencies needed to determine how much water the projects would have had stored upstream or exported from the Delta at the time of the EWA action absent the EWA's modifications of their operations. This was the "base case". A number of factors were considered in calculating the base case, including:

- The amounts of water available in the rivers and upstream storage;
- Available export, conveyance, and south-of-Delta storage capacity; and
- The amount of the water the project could, and would choose to, deliver within the regulatory baseline standards in effect at the time of the EWA action.

For the CVP, which was not impacted by the EWA this year but likely will be in the future, base case operations first had to be reconciled with effects of (b)(2) operations before EWA impacts could be calculated.

While the projects operate to maximize deliveries to contractors, they do not necessarily operate to export Delta water to the limits of the baseline regulatory standards all the time. For example, when San Luis Reservoir, the main CVP and SWP storage site south of the Delta, fills to capacity, the projects must reduce exports to demand levels, unless alternative south-of-Delta storage, such as a groundwater bank, is available. In another scenario, during the February - June period when the E/I ratio is more restrictive, the projects may choose to hold water upstream rather than release it because the majority of that water would have been required to flow through the Delta, unavailable for export. Similarly, when an export cut is requested by the EWA (or (b)(2)), the projects may choose to satisfy the request for the lower export rate by holding the water upstream, effectively minimizing the delivery impacts of the export cut by saving the water for export later in the season.

The Project Agencies were also responsible for tracking and accounting for EWA water assets and debts stored in various locations and during transfer from one location to another. Water is almost never moved around the system without losses. For example, in July when 50,000 AF of EWA water purchased and stored north of the Delta was transferred south to compensate for delivery impacts of earlier export cuts, 15% of the amount was lost as carriage water, netting the EWA only 42,500 AF of debt relief in San Luis Reservoir. When the EWA used its variable assets to acquire water, the amount gained was calculated based on comparison with the base case and, if the water was delivered to San Luis Reservoir, it was credited against any EWA debts held there.

Summary reports on the status of the EWA, including amounts and locations of assets and the water cost of actions, were reported on the CALFED Operations Group website[14] and regularly updated. However, particularly during the spring when the EWA made frequent modifications to project operations, results of daily and monthly accounting lagged, often by several months. In some cases revisions to the accounts were made months after the actions had occurred, adding uncertainty to the EWA balance sheet and complicating its decisions to undertake fish protective actions.

EVALUATING THE ENVIRONMENTAL WATER ACCOUNT

Implementation of the EWA in Water Year 2001 illustrated the enormous challenge of operating a novel and untested tool in the real world and in real-time. A great many talented and dedicated people worked very hard to collect and integrate the various pieces - funding, water, operational, modeling and accounting tools, environmental monitoring and decision guidelines - needed to make the EWA a reality. It is to their credit that it worked as well as it did. But, despite their efforts, did it work as well as it needed to?

Although actual EWA operations in Water Year 2001 were markedly different from those used in developing the EWA in a number of respects, this year's experience clearly demonstrated the potential of the tool and the value of a collaborative, science-

[14] EWA accounting summaries are posted at http://wwwoco.water.ca.gov/calfedops/ops/opsummary.pdf.

based, proactive management to protect fish in a heavily exploited watershed. But it also revealed serious flaws in the EWA's current structure and its supporting elements. Analysis of this year's operations also raises concerns about the EWA's future as CALFED proceeds with other components of its water supply enhancement and management plans. The following sections offer some perspectives on the EWA and its implementation in its inaugural year by analyzing examples of EWA and water management operations that highlight some of the strengths, weaknesses, ambiguities, and flaws in this new tool.

Winter-run Chinook Salmon Actions, February-March 2001

On March 5, the ESA-mandated take limit for winter-run chinook salmon[15] was exceeded (Figure 6, next page). While failure to satisfy ESA protections despite several EWA actions to protect the endangered fish and reduce take at the pumps was disturbing in itself, the cessation of EWA protective actions in the middle of this historic take exceedance and the inability of the EWA and Project Agencies to respond flexibly by using alternative operational strategies were both significant departures from the fish protection strategies specifically developed for this tool, and demonstrate serious problems with the current EWA structure and management.

During the winter-run chinook salmon take exceedance, EWA management was hampered by inadequate monitoring and analysis and, as the fish stubbornly persisted near the pumps, decisions were increasingly driven by EWA budget concerns rather than the needs of the fish. First, monitoring and analytical resources were inadequate to accurately assess biological conditions that required EWA intervention and to optimize utilization of EWA assets for fish protection. For example, results of Sacramento River and Delta monitoring for winter-run chinook salmon that were used to guide EWA-mediated export cuts were found to be poorly correlated with occurrence and densities of the fish at the south Delta pumps. Second, despite a well-documented, science-based rationale for the proscribed EWA protective action of an export cut to 6000 cfs, EWA managers abandoned this protection plan in favor of smaller export cuts apparently solely intended to reduce take, a strategy that arose from concerns over mounting EWA costs, exacerbated by an artificial and unnecessarily rigid monthly EWA budget, and the need to conserve the EWA's limited assets for protection of other listed species later

[15] The take limit for winter-run chinook salmon was 7,404 fish, 2% of the estimated juvenile population emigrating through the Delta. However, based on the unexpectedly high numbers of fish that appeared at the pumps as well as apparent conflicts in some of the data used to calculate juvenile population size, called the juvenile production estimate (JPE), a number of fisheries scientists, agency personnel and other stakeholder participants have questioned the accuracy of the JPE, suggesting that it underestimated the true number of juvenile fish, and that the resultant ESA take limit was therefore erroneously low. This raises the critical issue of when during the process the JPE should be evaluated and / or modified, and by whom.

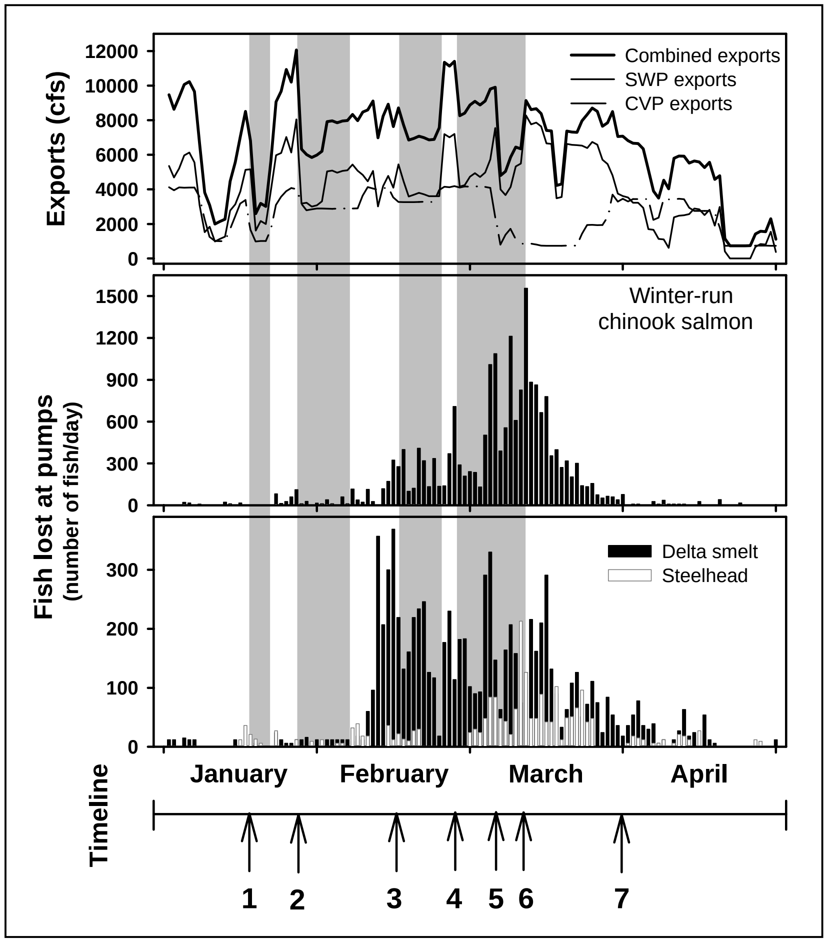

Figure 5. EWA actions, fish losses, and the sequence of events during the winter-run chinook salmon event in the winter of 2001.

Timeline events:

1. The first EWA fish protection action, reducing combined exports to 6000 cfs, is initiated to protect winter-run chinook salmon migrating down the Sacramento River. The action is triggered by results of Sacramento River monitoring and, for efficiency, is combined with an additional cut to provide specific flow conditions for a salmon survival study in the southern Delta. Sacrament River catch indices subsequently fall below trigger values and EWA action is terminated after 5 days.

2. The second EWA export cut to 6000 cfs is recommended based on increasing numbers of winter-run chinook salmon salvaged at the SWP, although the Sacramento River catch index is lower. The export reduction is shared equally between the SWP and CVP even though the majority of the salmon are being taken at the SWP. After five days, salvage declines but monitoring on the Sacramento River suggests that more fish are moving towards the Delta. To conserve EWA water, exports are reduced to 8000 cfs rather than 6000 cfs.

3. Loss of winter-run chinook salmon has increased dramatically and an export reduction to 7000 cfs, with all cuts limited to the SWP where 90% of the fish are salvaged in implemented. Loss of adult delta smelt has also increased. The EWA action is continued for eight days and then terminated, although salmon salvage rates remain high, based on concerns that the EWA has overspent it February budget and assets should be conserved for fish protection later in the year.

4. Winter-run chinook salmon and delta smelt losses increase and a series of export cuts at the SWP are implemented.

5. On March 5, the winter-run chinook salmon take limit is exceeded, with approximately 90% of the fish lost at the SWP. Combined exports are nearly 10,000 cfs. Two days later the CVP fills its share of San Luis Reservoir and cuts exports by 80%. The EWA briefly reduces exports to 4000 cfs but losses remain high. A request to use joint point of diversion, with the CVP pumping water for the SWP, is denied.

6. EWA-mediated export cuts are terminated on concerns that water assets budgeted for March had been expended and that EWA assets should be conserved for protection of other species later in the year.

7. By the end of March, nearly 20,000 winter-run chinook salmon have been lost at the pumps.

in the season. This shift in approach also exemplifies the potential conflict between implementing EWA actions designed to protect fish and promote recovery by broadly improving survival and those focused more narrowly on satisfying specific ESA requirements like take limits.

Ultimately, water budget concerns impelled the Management Agencies to terminate EWA actions, despite continuing record salvage levels and cumulative losses approaching twice the allowable limit. During development of the EWA, gaming exercises revealed that the EWA optimized its operations by acquiring as much debt during the winter and spring as it could reasonably expect to repay later in the year, with repayment anticipated largely through use of its variable assets and favorable hydrology. However, despite this result, the current EWA Operating Principles Agreement requires that EWA have sufficient collateral before undertaking an action. Therefore, regardless of expectations for future additional water acquisitions, the severe under-endowment of the EWA during this period of high risk to several listed fish species and, in particular, the absence of the supplemental 200,000 AF of water promised for the first year (both responsibilities of the Project Agencies), effectively prohibited the EWA from taking actions to protect endangered chinook salmon as it had been committed to do by the Management Agencies in the ESA assurances.

According to the ROD, in the event the combined protections of the regulatory baseline, the ERP, and the EWA were insufficient to satisfy ESA protections, an additional level of protection and water, Tier 3, would be made available. Disregarding the issue of whether ESA assurances should have been granted in the first place given the ambiguous status of Tier 3 protections (or voided on the basis of the EWA's incomplete asset portfolio), the monthly EWA budget structure adopted by the Management Agencies is not consistent with the ROD's commitment to provide Tier 3 protection. This year, when EWA actions to protect winter-run chinook salmon were terminated in order to conserve assets[16] for protection of other species later in the season, Management Agencies reportedly felt prohibited from invoking Tier 3 protections because, ironically, the EWA still retained some assets, a classic Catch-22 situation that needs immediate resolution.

Throughout the winter-run chinook salmon take exceedance, 90% of the fish were taken at the SWP. EWA-mediated export curtailments of SWP pumping were an appropriate response and likely provided greater benefit than similar cuts at the CVP (some of which were made using (b)(2) water). Then, a few days after the take limit was exceeded and as the EWA approached the (perceived) limits of its assets budgeted for use in March, the CVP filled its share of San Luis Reservoir and dramatically reduced its exports. This presented a potentially valuable opportunity to use a Joint

[16] Although the EWA was technically in debt at this time, the Management Agencies knew that several contracts to purchase additional water were nearly complete.

Point of Diversion action to shift pumping from the project having the disproportionately harmful impact on the fish, the SWP, while maintaining moderate export rates pumping either SWP or EWA water using the excess capacity of the CVP. At that time, absent substantially reducing SWP exports (using either EWA water or Tier 3 assets, which were both represented as unavailable), this was the only viable strategy for reducing take of the endangered fish and exactly the type of flexible and coordinated project operation with minimal impacts on deliveries envisioned by EWA designers. While use of excess CVP pumping capacity is unusual and it was not explicitly identified as an EWA tool, it has been done before (in fact, in June 2001, the CVP pumped water for the SWP water when the state project's aqueduct was under repair). However, the request submitted to the State Water Resources Control Board was denied because existing permits precluded the CVP from pumping water for purposes other than its own demands at this time of the year.

Delta Smelt Actions, April-June 2001

The spring of 2001 was the first time in several years that ESA-mandated take limits for juvenile delta smelt were not exceeded. At least some of the credit belongs to effective implementation of the EWA, which functioned to first support and then expand the benefits of the 30-day San Joaquin River flow enhancements and export reductions required under the San Joaquin River Agreement an described in the Vernalis Adaptive Management Plan (VAMP). Even though VAMP flow and export conditions were preset (and largely designed to protect San Joaquin basin salmon), intensive monitoring and analysis of delta smelt distributions and movements continued, before, during and after the 30-day VAMP period. Results were incorporated into hydraulic and particle tracking models, valuable technical support that was provided by the Project Agencies, and the possible effects of alternative protective actions, such as manipulation of the south Delta agricultural barriers, were tested regularly throughout the spring. This proactive and analytical approach was possible because of superior monitoring programs and availability of models that credibly described the fish's movements, a task admittedly easier with delta smelt than chinook salmon. It represented a significant improvement in technical collaboration between the Management and Project Agencies and in the

The delta smelt is found only in the Sacramento-San Joaquin Delta.

environmental and biological monitoring that will be necessary to optimize use of the EWA for fish protection.

SWP Water Management Operations, March 2001

Throughout the late winter and spring, the EWA carried a debt in San Luis Reservoir - the cumulative cost of export reductions made for protection of chinook salmon, steelhead and delta smelt exceeded the cumulative amount of water the EWA had stored in the reservoir (see Figure 3). However, when (or if) the SWP filled its share of the reservoir to capacity, the impacts of EWA actions on SWP deliveries would have been eliminated and the EWA debt forgiven. This strategy was consistently and effectively utilized in the gaming exercises that shaped the present configuration of the EWA and was an important tool for minimizing modeled EWA costs.

On March 19, one week after the EWA “ran out of water” and terminated protective actions for winter-run chinook salmon, the SWP came within a few thousand acre feet of filling San Luis. SWP forecasting and operations models indicated that the reservoir would fill within days, information that was shared with EWA managers. Anticipating the availability of excess pumping capacity and exportable water in the Delta, the SWP declared that “Article 21" water was available to its south-of-Delta contractors. Several contractors agreed to accept the water and deposit it in newly developed surface and groundwater storage. However, availability of this new storage enabled the contractors to take Article 21 water at unexpectedly high rates, approximately 4000 cfs, or 8,000 TAF per day, and effectively consumed the majority of the SWP export capacity. Thus, SWP export rates remained high but virtually all of the water bypassed San Luis Reservoir. Ultimately, the reservoir never filled, EWA debt was not spilled and was instead covered with purchased water, much of it transferred through the Delta at additional costs.

Article 21 Water

When the SWP fills its own south-of-Delta storage to capacity (nearly all of which is in San Luis Reservoir) and there is a temporary surplus of water available for export in the Delta, meaning export operations are not limited by either environmental or water quality standards like the E/I ratio, it can pump the extra water to contractors who have a place to store the water, for example in a groundwater bank. This water is referred to as Article 21, or “interruptible”, water.

Expanding storage capacity south of the Delta, for example through development of groundwater banks, is an important CALFED strategy for increasing water supply and improving water supply reliability. However, as the above example illustrates, these types of changes undercut the ability of the EWA to function as designed. When there are more places to store water south of the Delta, and when export water users have higher priority than the EWA, more water can be exported for consumptive uses. This reduces both the opportunities and ability of the EWA to recover costs or utilize variable assets like Joint Point of Diversion. Increased exports also increase EWA costs by creating more instances when the EWA may need to intervene for fish protection. In an alternative interpretation, these increases weaken the ability of the EWA to take actions necessary for the protection and recovery fish species in the watershed and Delta. CALFED's plans to increase maximum allowable export rates at the SWP to 8,500 cfs (from the present limit of 6,680 cfs) will likely have a similar effect of expanding EWA cost by increasing the frequency of necessary for fish protective actions, with the added burden of magnifying the costs of individual actions to reduce export rates to biologically less harmful levels.

The EWA was designed to facilitate flexible operation of the water projects for the benefit of fishery resources and the environment. Yet, the ultimate effects of many of CALFED's proposed measures to expand storage and conveyance capacity will be to exploit the little remaining operational flexibility in the system for the benefit of consumptive use. Without effective variable assets and the reliable ability to recover costs by utilizing operational flexibility and favorable hydrology, the EWA will essentially be limited to providing purchased water to directly compensate the water projects and their contractors for the consequences, expressed as water costs, of operating in a less harmful manner and within the limits the ESA-mandated restrictions on their permits. Unless it directly and equitably benefits from proposed expansions in storage and conveyance capacity, and unless these new projects are subject to operational constraints that avoid new environmental costs, the EWA's ability to accomplish CALFED's objectives for fish protection and recovery will be severely compromised.

Water Project Operations and EWA Accounting

The state and federal water projects have large amounts of discretion in their operations, making accounting for EWA impacts on water project operations a complex, labor intensive and time consuming process. As currently implemented, determining EWA costs relative to the projects' calculated "base case" operations, this accounting system is likely biased in favor of maximizing project deliveries and, and as a consequence, inflates EWA costs.

The projects obviously operate to maximize water deliveries to contractors. However, in real-time, or day-to-day, operations, their operational decisions in this extremely complex and massively exploited system are subject to the vagaries of both nature and demand - unpredictable variations in precipitation, runoff, and local project and riparian diversions that alter storage levels and flows. After years of practice and through use of elaborate forecasting and operational models, the Project Agencies generally respond to these fluctuations extremely well. But they are not perfect. Further, in order to avoid violating regulatory standards such as the E/I ratio or, for the SWP, the 6,680 cfs cap on pumping, the water projects always operate slightly below the maximum allowable level, a buffer against unexpected changes in flows or operational errors.

Before the EWA, the amount of water the projects actually delivered was the "base case". With the EWA in operation, the Project Agencies, by using actual data on runoff and flows, rather than projections, in their models to calculate base case operations after the fact, are able to optimize their operations and deliveries to a greater degree than would have been possible with real-time operations. Similarly, EWA use of some of its variable assets provides extra water to the water projects. For example, during the brief EWA-authorized relaxation of the E/I ratio in October 2000, the EWA acquired only 2,000 AF because the water projects were able to achieve export levels only slightly above the regulatory standard, 65%. However, the projects, which had been operating three to five percentage points below the limit, enjoyed larger benefits, capturing and exporting 1,000-1,500 AF more per day than they would have without the EWA action. In effect, the EWA may be functioning to increase water deliveries by sheltering the projects from inadvertent operational mistakes, inefficiencies, and the necessity of maintaining regulatory safety margins - a result that could be interpreted as a publicly funded windfall to water contractors from a tool intended to benefit the environment.

Measuring the Effectiveness of EWA Actions

While the Management Agencies collected large quantities of data using a variety of monitoring programs to help guide their use of the EWA, there was little monitoring aimed at measuring the effects of EWA actions, with the exception of continuous records for fish salvage numbers at the CVP and SWP. Admittedly, measuring the effects of EWA actions, either in terms of effects on local hydraulics or on fish populations, is not an easy task. Most EWA actions are short in duration and small in scale relative to other conditions in the system. Progress towards the EWA's biological objectives, to improve survival by acting during specific periods when the fish are most vulnerable to water operation impacts, for example when young salmon migrate through the Delta, may not be detectable or measurable for years when the adult fish return to spawn. Nevertheless, there were some opportunities to gather more immediate biological information. As an example, the EWA-initiated flow enhancement on the American River (ultimately paid for using (b)(2) water) was intended to protect chinook salmon and steelhead redds, yet neither the number of redds potentially affected nor the number of redds that benefited from the action were apparently counted or reported.

For some species and some EWA actions, it is possible to estimate the benefits using existing statistical models that relate, for example, juvenile chinook salmon survival to combined export rates. Similar quantitative relationships need to be developed for other species and other types of EWA-mediated hydraulic manipulations. CALFED and the Management Agencies have moved to address this issue. CALFED has incorporated EWA review into its Science Program and, in coordination with the Management and Project Agencies, sponsored two day-long workshops examining this year's implementation of the EWA in relation to chinook salmon and delta smelt. Two technical reports, one describing the mechanics of EWA operations in Water Year 2001 and the other analyzing the fish protection actions, are currently in preparation and will be discussed in a multi-day workshop with CALFED Independent Science Board members. CALFED has also convened an independent team of scientists to develop an approach and a suite of measurable indicators for evaluating the effects of EWA actions.

Understanding and quantifying the effects of EWA actions on fishery resources is imperative for at least two reasons. First, to effectively use this tool, Management Agencies need to know which types of EWA-mediated modifications in water project operations provide the greatest benefits to fish. For example, if reducing the numbers of adult delta smelt taken at the pumps during the winter provides a greater population benefit than similar protection for juveniles in the spring, then EWA resources for protection and recovery of this species should be focused on winter-time export reductions. Second, if the EWA is to be preferred as a management measure over other regulatory or non-regulatory alternatives, its sponsors need to demonstrate that it is more effective in providing the intended benefits to fishery resources, protection of fish from water project impacts and recovery of depressed populations, particularly for ESA-listed species. The answers to both of these issues are unknown - a graphic illustration of the experimental nature of this water management and fish protection tool.

Finally, implicit in any discussion of the optimal use of the EWA for fish protection is a larger question: given the EWA's responsibilities to satisfy ESA protection for multiple listed species, is the EWA an adequate vehicle for broadly improving habitat conditions impaired by water management operations (on the assumption that such actions will help provide the level of protection required by the ESA) or should it be only used to minimize the direct impacts of project operations and satisfy other important and highly visible ESA-required protections like take limits? From a regulatory standpoint, ensuring compliance of the water projects with the operational requirements contained in the Biological Opinions and their permits may take precedence. Given its limited resources, this obviously reduces the EWA's ability to implement protective actions other than export curtailments. Are there any other measures that can be implemented to complement the EWA?

RECOMMENDATIONS

CALFED has authorized the EWA for three more years with the expectation that, if it proves to be a workable approach that satisfactorily protects fishery resources without impacting water deliveries, it will be continued. Based in this analysis of the EWA, there are a number of structural and conceptual issues that should be resolved before this tool can be utilized as intended and its effectiveness fairly judged.

1. The EWA that was implemented in Water Year 2001 was incomplete, under-endowed, and constrained in its function. It was not the fish protection and water management tool promised in the CALFED ROD. This shortcoming needs to be rectified immediately

1a. CALFED should work with the Project Agencies to insure that all elements of the EWA, as described in the ROD, are unequivocally and fully in place before December 2001 and the onset of the period of highest risk to fish species of concern, when EWA fish protections are most likely to be implemented.

- At a minimum the EWA should be supplied with at least 50% of annual purchased water supplies and 100% of the one-time deposit of 200,000 AF of water.
- Tier 3 protections, including secure funding, identification of potential water sources, and an implementation strategy and scientific review process capable of rapid response and decision making, should also be in place by December 2001.
- A secure, multi-year funding base should be developed. Funding the EWA through annual appropriations is risky and impairs the ability of Project Agencies to negotiate water and groundwater storage acquisitions and options. CALFED should pursue funding the EWA through volume-based user fees, appropriately allocating the costs of mitigating environmental and fisheries impacts of water project operations to water project and contractor beneficiaries.

1b. Management Agencies should not grant ESA assurances while the EWA is still in an experimental, developmental phase. At the least, such assurances should be withheld until the EWA has been fully supplied with specified assets, operational tools, and Tier 3 supplemental protections before next winter. Management Agencies should reserve the right to void ESA assurances if baseline regulatory protections and/or Project Agency commitments are not fully satisfied during implementation of the ESA in any water year.

1c. The Project Agencies should develop plans and/or obtain permits necessary to allow greater flexibility operations of the CVP and SWP south Delta facilities, for example the South Delta Water Elevation Plan necessary to implement Joint Point of Diversion operations at the CVP.

2. The EWA was designed to provide fishery protection at current levels of water project operations - it was not intended to mitigate new or additional impacts resulting from implementation of other CALFED programs. Measures to first avoid new impacts and then to offset them need to be developed and adopted by CALFED.

2a. Any changes in CVP and SWP export, storage and conveyance capacity must be designed to avoid foreseeable environmental impacts which would have to be offset by use of the EWA. The Management Agencies should adopt the principle that the EWA will not be used to offset foreseeable environmental impacts of these changes.

2b. EWA size and operational tools must be adjusted to compensate for unforeseeable water project impacts as changes in SWP and CVP export, conveyance and storage capacity become operational. To ensure balanced progress towards enhancements in fish protections and water supply, CALFED should dedicate at least 50% of the yield from any change in SWP or CVP capacity to the EWA.

2c. Using EWA and operational data supplemented by modeling studies, CALFED should evaluate the impacts of new operational capacity on the efficacy of EWA variable assets and adjust the EWA Interim Protocols as necessary to compensate for any reductions in EWA capacity.

3. Effective use of the EWA's limited resources for fish protection requires good information, a good plan, and better use of and coordination with other CALFED elements. The Management Agencies need to clarify EWA objectives and improve the monitoring and analytical tools that guide EWA decisions.

3a. Management Agencies need to clarify their objectives for the EWA beyond that of "protection and recovery", and/or clarify the role of the EWA within a larger suite of management measures to implement the ESA, the CVPIA, and the ERP. For example, is the purpose of the EWA to increase survival through habitat improvements or to reduce take at the export pumps to ESA-mandated limits? In theory, the answer to this question should probably be based on which type of management provides the greatest benefit to the species. However, the limited assets and permit assurances associated with the EWA constrain its ability to secure the broadest range of benefits. CALFED and the Management Agencies should allocate sufficient funding to environmental water management programs that complement the EWA, primarily the ERP Environmental Water Program to acquire instream flows, and should devote sufficient staff resources to coordination and integration between the EWA and other programs, including the EWP, the CVPIA (b)(2) and (b)(3) programs, the water use efficiency program and the conjunctive use/groundwater management program.

3b. Timely and accurate environmental and biological monitoring is essential for effective use of the EWA. Management Agencies, with assistance from CALFED, should increase the scope and flexibility of their environmental and fish monitoring efforts, develop quantitative models relating results of monitoring and operational data with fish abundance, movements and distributions, and vulnerability to the CVP and SWP pumps, and refine decision guidelines for EWA and other discretionary actions.

3c. The Management Agencies should revise their present EWA water budget schedules in relation to CALFED’s Tier 3 implementation strategy, and as fish protection objectives and strategies are refined.

3d. Using operational, and biological data from Water Year 2001 and the computer models used to develop the EWA, the Project and Management Agencies should re-analyze EWA and water project operations by “gaming” the year. Alternative operational and fish protection strategies should be compared and evaluated and the results applied to improve EWA management in upcoming years and to guide changes in EWA structure and operational rules to improve its effectiveness and to keep pace with operational changes resulting from other CALFED programs.

4. The EWA is essentially a large scale and expensive experiment, which may or may not provide the benefits assumed in ESA permit assurances. It is imperative that the results of its actions be measured and evaluated.

4a. Specific hypotheses regarding the efficacy of EWA to reduce impacts of water project operations on fish species should be developed and tested using analyses of existing data, results of ongoing experiments, and modeling simulations.

4b. The EWA’s effectiveness for reducing project-related impacts in the Delta and greater watershed should be evaluated using multiple indicators, including those for fish survival, movement and distribution, salvage rates, instream flows and Delta hydrodynamics, ecosystem function and habitat quality.

5. Cooperation and coordination between the Project and Management Agencies is essential for effective use of the EWA. This year's operations were promising and demonstrated some exciting synergies in the technical tools and talents of the two groups. However, some ambiguities and possible biases in forecasting and accounting should be clarified.

5a. The Interim Protocols for EWA Operations should be revised to clarify ambiguities and possible biases in base case accounting protocols, Article 21 water and San Luis Reservoir operations relative to EWA debt, and flexible and cooperative operation of the two pumping plants.

5b. Modeling and technical support provided by the Project Agencies has the potential to substantially improve Management Agency analyses and decision making for EWA actions. CALFED and the Project Agencies should encourage this collaboration and provide resources to support these activities.

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